TMDL FOR TURBIDITY FOR BAYOU COCODRIE (SUBSEGMENT 101601) IN THE RED RIVER BASIN, LOUISIANA

FINAL
September 25, 2006

TMDL FOR TURBIDITY FOR BAYOU COCODRIE (SUBSEGMENT 101601)
IN THE RED RIVER BASIN, LOUISIANA

Prepared for

US EPA Region 6
Water Quality Protection Division
Oversight and TMDL Team
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Contract No. 68-C-02-108
Task Order 96

Prepared by

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

FINAL
September 25, 2006

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards, and to develop total maximum daily loads (TMDLs) for those waterbodies. A total maximum daily load is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be allocated to point sources and nonpoint sources discharging to the waterbody. This report presents a TMDL that has been developed for turbidity for Bayou Cocodrie (subsegment 101601).

Bayou Cocodrie (subsegment 101601) is located southwest of Vidalia, Louisiana, in the Red River basin in eastern central Louisiana. This subsegment encompasses 99 mi^2. The two largest land uses are row crops (74%) and wetlands (20%).

This waterbody was included on the Louisiana Department of Environmental Quality (LDEQ) final 2004 303(d) list as not supporting its designated uses of fish and wildlife propagation and outstanding natural resource waters. It was ranked as priority #1 for TMDL development. Irrigated and non-irrigated crop production was identified as a suspected cause of impairment in the 303(d) list.

LDEQ historical water quality data were available for one monitoring location in subsegment 101601. These data were analyzed for long term trends, seasonal patterns, relationships between concentration and stream flow, and relationships between turbidity and total suspended solids (TSS). No historical trends, seasonal patterns, nor relationships with flow were apparent in these data.

Because turbidity cannot be expressed as a mass load, this turbidity TMDL was expressed using TSS as a surrogate for turbidity. A regression between TSS and turbidity was developed and was used to develop a target TSS concentration to correspond with the numeric turbidity criterion from the Louisiana water quality standards. Because this subsegment is designated as an outstanding natural resource water, the applicable numeric criterion for turbidity is 25 NTU. Based on the regression, the target TSS concentration corresponding to 25 NTU was 26 mg/L.

The TMDL in this report was developed using the load duration curve methodology. This method illustrates allowable loading at a wide range of stream flow conditions. The steps for applying this methodology for the TMDL in this report were:

1. Developing a flow duration curve,
2. Converting the flow duration curve to load duration curves,
3. Plotting observed loads with load duration curves,
4. Calculating the TMDL components, and
5. Calculating percent reductions.

An implicit margin of safety (MOS) was incorporated through the use of conservative assumptions. The primary conservative assumption was to treat TSS as a conservative parameter that does not settle out of the water column. Also, 10% of the TMDL was set aside as an explicit allocation for future growth (FG).

Because point sources were considered to have a negligible effect on existing violations of water quality standards, all of the load reductions were assigned to nonpoint sources. The wasteload allocation (WLA) for point sources, the load allocation (LA) for nonpoint sources, and the nonpoint source percent reduction needed are summarized in Table ES.1.

Table ES.1 Summary of turbidity TMDL.

Subsegment Number	**Waterbody Name**	**Parameter Causing Impairment**	**Loads (tons/day of TSS)**					**Percent Reduction Needed**
			WLA	**LA**	**MOS**	**FG**	**TMDL**	
101601	Bayou Cocodrie	Turbidity	0	10.06	implicit	1.12	11.18	87%

Hurricane Katrina made landfall on Monday, August 29, 2005 as a category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80% of New Orleans and large areas of coastal Louisiana. Much of the area that was flooded in Hurricane Katrina was re-flooded by storm surge from Hurricane Rita. Both Hurricanes Katrina and Rita have caused a significant amount of change in sedimentation and water quality in south Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will rebuild while others will relocate. The hurricanes expedited the loss of coastal land and modified the hydrology of some of the coastal waterbodies. Several federal and state agencies including the Environmental Protection Agency (EPA) and LDEQ are engaged in collecting environmental data and assessing the recovery of the Gulf of Mexico waters. These TMDLs were developed based on the pre-hurricane conditions. Therefore, the post-hurricane conditions and other factors may delay the implementation of these TMDLs or render these TMDLs obsolete or may require modifications of the TMDLs. While hurricane effects may be valid for some TMDLs, any deviation from the TMDLs should be justified based on site-specific data and/or information.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

1.0 INTRODUCTION

This report presents a total maximum daily load (TMDL) for turbidity for subsegment 101601 (Bayou Cocodrie) in the Red River basin in eastern central Louisiana. This subsegment was included on the Louisiana Department of Environmental Quality (LDEQ) final 2004 303(d) list as not supporting its designated uses of fish and wildlife propagation and outstanding natural resource waters (LDEQ 2005a). The sources of contamination and causes of impairment from the LDEQ 303(d) list are shown in Table 1.1. The TMDL in this report was developed in accordance with Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency's (EPA) regulations in 40 CFR 130.7.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant, and to establish the load reduction that is necessary to meet the water quality standard in that waterbody. The TMDL is the sum of the wasteload allocation (WLA), load allocation (LA), future growth (FG), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to nonpoint sources, including natural background. The MOS is a percentage of the TMDL that takes into account any lack of knowledge concerning the relationship between pollutant loadings and water quality, and the FG is reserved for future increases in loads to the waterbody.

Table 1.1. Subsegments and parameters for impairments addressed in this report.

Subsegment Number	Subsegment Name	Source of Information[1]	Impaired Use[2]	Suspected Causes of Impairment: Chloride	Sulfate	TDS	Sediment/ Siltation	TSS	Turbidity	Suspected Sources of Impairment	TMDL Priority (1 = highest)
101601	Bayou Cocodrie	LDEQ 303(d)	FWP, ONR						X	Irrigated and non-irrigated crop production	1

Notes:

1. Source of information is the final 2004 LDEQ 303(d) list.
2. FWP=Fish and Wildlife Propagation, ONR=Outstanding Natural Resource Waters

2.0 BACKGROUND INFORMATION

2.1 General Information

The study area for this report consists of subsegment 101601 (Bayou Cocodrie), which is located southwest of Vidalia, Louisiana in the Red River basin in eastern central Louisiana (Figure A.1 in Appendix A). General information about this subsegment is presented in Table 2.1. Bayou Cocodrie is located between the Black River and the Mississippi River. Subsegment 101601 includes the portion of Bayou Cocodrie from Little Cross Bayou to Wild Cow Bayou. The portion of Bayou Cocodrie immediately upstream is in subsegment 101607 and the portion of Bayou Cocodrie immediately downstream is subsegment 101606.

Table 2.1. Background information for subsegment 101601.

Subsegment	Waterbody	Parish	Hydrologic Unit	Area
101601	Bayou Cocodrie	Concordia	08040306	99 mi^2

2.2 Topography

Bayou Cocodrie is located in the Mississippi Alluvial Plain ecoregion. Most of this subsegment has very little relief, with elevations throughout the subsegment ranging only from about 45 feet to 55 feet above sea level. The only areas with significant slopes are along each side of Bayou Cocodrie and its larger tributaries. Based on US Geological Survey (USGS) 1:24,000 topographic maps, most of the Bayou Cocodrie channel within this subsegment is about 15 feet lower than the surrounding alluvial plain. This elevation difference creates a potential for gully erosion and headcuts as runoff flows from the alluvial plain into ditches towards Bayou Cocodrie.

2.3 Soils

Soil textures for the study area were compiled from the STATSGO database, which is maintained by the United States Department of Agriculture (USDA) Natural Resources

Conservation Service (NRCS). As shown in Table 2.2, the soil textures in the study area are primarily clays.

Table 2.2. Soil textures for subsegment 101601.

Soil Texture	Percent Coverage
Clay	65%
Loam	4%
Silty clay	18%
Silty clay loam	5%
Silt loam	4%
Other textures	4%
Total	100%

2.4 Land Use

Land use data for the study area were compiled from the United States Geological Survey (USGS) 1992 National Land Cover Dataset (USGS 2000). Although these data were based on satellite imagery from the early 1990's, more recent land use data for this area are not available at this time. The spatial distribution of these land uses is shown on Figure A.2 (located in Appendix A) and land use percentages are shown in Table 2.3. The two largest land uses are row crops (73.6%) and wetlands (19.6%).

Table 2.3. Land use percentages for subsegment 101601.

Land Use	Percent Coverage
Water	1.5%
Urban/Transportation	0.1%
Barren	0.0%
Forest	1.6%
Shrubland/Grassland	0.0%
Pasture/Hay	2.5%
Row Crops	73.6%
Small Grains	1.0%
Urban/Recreational Grasses	0.1%
Wetlands	19.6%
Total	100.0%

2.5 Description of Hydrology

Average annual precipitation in the study area is 55 to 60 inches. Precipitation is lowest in the late summer and highest during the winter.

There is no current USGS flow gaging station located on Bayou Cocodrie. The nearest USGS flow gage with recent data is on Bayou des Glaises Diversion Channel (07383500), which is approximately 10-20 miles south of the study area. For this TMDL, flows for Bayou Cocodrie were estimated from Bayou des Glaises Diversion Channel flows per unit of watershed area.

2.6 Water Quality Standards

Water quality standards for Louisiana are included in the Title 33 Environmental Regulatory Code (LDEQ 2005b). Designated uses for subsegment 101601 (Bayou Cocodrie) are primary and secondary contact recreation, fish and wildlife propagation, agriculture, and outstanding natural resource waters.

The Title 33 Environmental Regulatory Code sets a turbidity criterion of 25 NTU for outstanding natural resource waters. This criterion is the same for all ecoregions in the state. Therefore, the value of 25 NTU was used as the turbidity criterion for this TMDL.

2.7 Nonpoint Sources

The 303(d) listing for subsegment 101601 (Bayou Cocodrie) indicates irrigated and non-irrigated crop production as a suspected source of the turbidity impairment (Table 1.1).

2.8 Point Sources

A list of point source discharges in the study area was generated by LDEQ using their TEMPO and PTS databases. Based on this list, there is only one permitted point source located in subsegment 101601. Information for this point source discharge was obtained by FTN Associates, Ltd. (FTN) from LDEQ's Electronic Document Management System (EDMS) and is shown in Table 2.4. This is a small discharge and does not have permit limits for either turbidity or total suspended solids (TSS).

Table 2.4. Point sources in subsegment 101601.

File Number	Facility Name	Location	Outfall	Sampled/ Estimated/ Design Flows	Flow Units	Rec. Water	TSS Permit Limits	Included in Turbidity TMDL?
LAG540488	Taylor's Trailer Park	Vidalia, 4 m SW on Airport Rd.	001	9000	gpd	Cocodrie Bayou	NA	No

2.9 Previous Water Quality Studies

There are no known previous water quality studies for subsegment 101601.

3.0 EXISTING WATER QUALITY FOR TURBIDITY AND TSS

3.1 General Description of Data

Turbidity and TSS data have been collected by LDEQ at one water quality station within the study area (station 1228). The location of this sampling site is shown on Figure A.1 (located in Appendix A). Table 3.1 shows a summary of the turbidity data, including the percentage of values above the turbidity criterion of 25 NTU. Table 3.2 shows a summary of TSS data for the same water quality station. TSS data are included in this summary because TSS is needed as a surrogate parameter for expressing the turbidity TMDL. A time series plot of data for the entire period is shown on Figure B.1 for turbidity and Figures B.2 for TSS (Appendix B). These data were obtained from LDEQ.

3.2 Seasonal Patterns

For both turbidity and TSS, the highest values occurred during winter and early spring (Figures B.1 and B.2). These high values during winter and early spring could be due to runoff from cropland because during that time of year cropland usually does not have as much cover on the ground to prevent erosion. However, additional data would be needed to confirm a seasonal pattern..

Table 3.1. Summary of turbidity data for subsegment 101601.

LDEQ Station Number	1228
Station Description	Bayou Cocodrie south of Monterey, Louisiana
Subsegment Number	101601
Period of Record	1/28/02 – 12/16/02
Number of Values	12
Minimum (NTU)	10
Maximum (NTU)	240
Median (NTU)	30
Number of Values > 25 NTU	9
Percent of Values > 25 NTU	75%

Table 3.2. Summary of TSS data for subsegment 101601.

LDEQ Station Number	1228
Station Description	Bayou Cocodrie south of Monterey, Louisiana
Subsegment Number	101601
Period of Record	1/28/02 – 12/16/02
Number of Values	12
Minimum (mg/L)	12
Maximum (mg/L)	168
Median (mg/L)	36

3.3 Relationships of Turbidity and TSS vs. Flow

Plots of turbidity and TSS versus estimated stream flow were also developed to examine any correlation between these water quality parameters and stream flow rates (Figure B.3 and B.4). These plots show a general (although inconsistent) trend of increasing turbidity and TSS with increasing stream flow. The results from one of the sampling events (11/19/2002; flow per unit area = 6.67 cfs/mi2) do not follow this trend.

3.4 Relationship Between TSS and Turbidity

A plot of TSS versus turbidity (Figure B5) shows a noticeable correlation, with higher turbidity levels tending to correspond with higher TSS concentrations. Linear regression was performed on the natural logarithms of turbidity and TSS. The results of this regression are summarized in Table 3.3. The regression was performed using the natural logarithms of the data (rather than the raw data values) because turbidity and TSS usually fit a lognormal distribution better than a normal distribution.

Table 3.3. Summary of results of linear regression of turbidity and TSS.

Sampling Station	Regression Equation	Number of Data	R^2	Significance Level (P value)
1228	Turbidity = $0.3867 * TSS^{1.2787}$	12	0.93	5.5×10^{-7}

The strength of the linear relationship is measured by the coefficient of determination (R^2) calculated during the regression analysis (Zar 1996). The R^2 value is the percentage of the total variation in ln turbidity that is explained or accounted for by the fitted regression (ln TSS). For station 1228, 93% of the variation in turbidity is accounted for by TSS and the remaining 7% of variation in turbidity is unexplained. The unexplained portion is attributed to factors other than TSS. The R^2 value of 0.93 indicated a strong correlation between TSS and turbidity.

The statistical significance for the regression was evaluated by computing the “P value” for the slope of the regression line. The P value is essentially the probability that the slope of the regression line is really zero. Thus, a low P value indicates that a non-zero slope calculated from the regression analysis is statistically significant. For this regression, the P value was much less than 0.05 (Table 3.3), which is considered statistically significant.

4.0 TMDL DEVELOPMENT

4.1 Seasonality and Critical Conditions

EPA regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Also, both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to consider seasonal variations for meeting water quality standard. Therefore, the historical data and analyses discussed in Section 3.0 were used to evaluate whether there were certain flow conditions or certain periods of the year that could be used to characterize critical conditions.

Although turbidity and TSS values appeared to be slightly higher during the winter and early spring, there was not enough data to confirm the pattern. Based on these analyses, the TMDL in this report was not developed on a seasonal basis. The methodology used to develop this TMDL (load duration curve) addresses a wide range of flow conditions.

4.2 Water Quality Targets

Turbidity is an expression of the optical properties in a water sample that cause light to be scattered or absorbed and is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter; soluble colored organic compounds; and plankton and other microscopic organisms (Standard Methods 1999). Turbidity cannot be expressed as a load as preferred for TMDLs. To achieve a load-based value, turbidity is often correlated with a surrogate parameter such as TSS that can be expressed as a load. For this turbidity TMDL, the relationship between turbidity and TSS presented in Section 3.4 was used to develop a target TSS concentration (i.e., a numeric endpoint for the TMDL). Table 4.1 shows the target TSS concentration calculated from the turbidity criterion in the water quality standards.

.

Table 4.1. Target TSS concentration for turbidity TMDL.

Water Quality Station	Regression Equation	Subsegment	Turbidity Criterion	Target TSS Concentration
1228	Turbidity=0.3867*TSS$^{1.2787}$	101601	25 NTU	26 mg/L

4.3 Methodology for TMDL Calculations

The methodology used for the TMDL in the report is the load duration curve. Because loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. The basic elements of this procedure are documented on the Kansas Department of Health and Environment (KDHE) web site (2005). This method was used to illustrate allowable loading at a wide range of flows. The steps for how this methodology was applied for the TMDL in this report can be summarized as follows:

1. Develop a flow duration curve (Section 4.4).
2. Convert the flow duration curve to load duration curves (Section 4.5).
3. Plot observed loads with load duration curves (Section 4.6).
4. Calculate TMDL, MOS, FG, WLA, and LA (Sections 4.7 - 4.9).
5. Calculate percent reductions required to meet water quality standards (Section 4.10).

4.4 Flow Duration Curve

A flow per unit area duration curve was developed for this subsegment. Daily streamflow measurements from Bayou des Glaises Diversion Channel at Moreauville, Louisiana (USGS gage number 07383500) were sorted in increasing order and the percentile ranking of each flow was calculated. The data from the Bayou des Glaises Diversion Channel gage were used because the load duration methodology requires that the same flow data be used for developing the flow duration as for calculating observed loads from sampling data. The Bayou des Glaises Diversion Channel gage was the closest flow gage with a similar watershed with flow data during 2002 (the year that water quality sampling occurred in Bayou Cocodrie). The flow duration curve is shown in Figure C.1 (located in Appendix C).

4.5 Load Duration Curves

The flows per unit area from the flow duration curve were multiplied by the target TSS concentration (from Section 4.2) to make an allowable load per unit area duration curve. The load duration curve is a plot of pounds per day per mi^2 of drainage area versus the percent exceedances from the flow duration curve. The load duration curve is shown in Figure C.2 (in Appendix C). The calculations for the load duration curve are shown in Table C.1.

The load duration curve is beneficial when analyzing monitoring data with its corresponding flow information plotted as a load. This allows the monitoring data to be plotted in relation to its place in the flow continuum. Assumptions of the probable source or sources of the impairment can then be made from the plotted data.

The load duration curve shows the calculation of the TMDL at any flow rather than at a single critical flow. The official TMDL number is reported as a single number, but the curve is provided to demonstrate the value of the acceptable load at any flow. This will allow analysis of load cases in the future for different flow regimes.

4.6 Observed Loads

Observed loads were calculated by multiplying each observed TSS concentration by the flow per unit area on the sampling day. These observed loads were then plotted versus the percent exceedances of the flow per unit area on the sampling day and placed on the same plot as the load duration curve (Figure C.2).

This plot provides visual comparisons between observed and allowable loads under different flow conditions. Observed loads that are plotted above the load duration curve (identified as “TMDL - FG” curve in the legend) represent conditions where observed water quality concentrations exceed the target concentrations. Observed loads below the load duration curve represent conditions where observed water quality concentrations were less than target concentrations (i.e., not violating water quality standards).

4.7 TMDL, MOS, and FG

Each TMDL was calculated as the area under the load duration curve. Because the load duration curve was expressed in mass per unit drainage area, the area under the curve (lb/day/mi^2) was multiplied by the subsegment drainage area.

Both Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 require TMDLs to include a MOS to account for uncertainty in available data or in the actual effect that controls will have on the loading reductions and receiving water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly through conservative assumptions used in establishing the TMDL. For this turbidity TMDL, an implicit MOS was incorporated through the use of conservative assumptions. The primary conservative assumption was calculating the TMDL assuming that TSS is a conservative parameter and does not settle out of the water column. In addition to the implicit MOS, an explicit FG was set equal to 10% of the TMDL.

4.8 Point Source Loads

For this TMDL, the WLA for the point source was set to zero because the surrogate being used for turbidity (TSS) is considered to represent inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by the point source in subsegment 101601 (a trailer park) are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources are already addressed by LDEQ through their permitting of point sources to maintain water quality standards for DO. The WLA to support this turbidity TMDL will not require any changes to the permits concerning organic suspended solids.

4.9 Nonpoint Source Loads

The LA for nonpoint sources was set equal to the TMDL minus the MOS, FG, and the WLA. For this TMDL, the LA was effectively the TMDL minus FG because the WLA was zero and the MOS was implicit. Calculations for the TMDL are shown in Appendix C.

4.10 Percent Reductions

In addition to calculating allowable loads, estimates were made for percent reductions of nonpoint source loads that would be needed for all of the observed loads to be on or below the load duration curve. The observed loads of TSS at LDEQ sampling station 1228 were reduced until none of the loads were above the load duration curve. The results of these percent reduction calculations are shown in Table 4.2.

Table 4.2. Summary of turbidity TMDL.

Subsegment Number	Waterbody Name	Parameter Causing Impairment	Loads (tons/day of TSS)					Percent Reduction Needed
			WLA	LA	MOS	FG	TMDL	
101601	Bayou Cocodrie	Turbidity	0	10.06	implicit	1.12	11.18	87%

5.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the State antidegradation policy (LAC 33:IX.1109.A).

LDEQ will work with other agencies such as local Soil Conservation Districts to implement nonpoint source best management practices in the watershed through the 319 programs. LDEQ will also continue to monitor the waters to determine whether standards are being attained.

In accordance with Section 106 of the federal Clean Water Act, and under the authority of the Louisiana Environmental Quality Act, the LDEQ has established a comprehensive program for monitoring the quality of the State's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the State's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the State's biennial 305(b) report (Water Quality Inventory) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a 4-year cycle. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the 4-year cycle. Sampling is conducted on a monthly basis to yield approximately 12 samples per site each year the site is monitored. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, approximately one half of the State's waters are newly assessed for each 305(b) and 303(d) listing biennial cycle, with sampling occurring statewide each year. The 4-year cycle follows an initial 5-year rotation that covered all basins in the state according to the TMDL priorities. This will allow the LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

Hurricane Katrina made landfall on Monday, August 29, 2005 as a category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80% of New Orleans and large areas of coastal Louisiana. Much of the area that was flooded in Hurricane Katrina was re-flooded by storm surge from Hurricane Rita. Both Hurricanes Katrina and Rita have caused a significant amount of change in sedimentation and water quality in south Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will rebuild while others will relocate. The hurricanes expedited the loss of coastal land and modified the hydrology of some of the coastal waterbodies. Several federal and state agencies including EPA and LDEQ are engaged in collecting environmental data and assessing the recovery of the Gulf of Mexico waters. This TMDL was developed based on the pre-hurricane conditions. Therefore, the post-hurricane conditions and other factors may delay the implementation of this TMDL or render this TMDL obsolete or may require modifications of the TMDL. While hurricane effects may be valid for some TMDLs, any deviation from the TMDLs should be justified based on site-specific data and/or information.

6.0 PUBLIC PARTICIPATION

Federal regulations require EPA to notify the public and seek comment concerning TMDLs it prepares. The TMDL in this report was developed under contract to EPA, and EPA held a public review period seeking comments, information, and data from the public and any other interested parties. The notice for the public review period was published in the Federal Register on July 20, 2006, and the review period closed on August 21, 2006. Additional comments will be accepted through October 20, 2006. These comments will be reviewed, and this TMDL may be revised if appropriate.

Comments were received from LDEQ, the Gulf Restoration Network, and six individuals. Comments and additional information submitted during this public comment period were used to revise this TMDL report. The comments and responses to this TMDL will be included in a separate document that will include comments on similar TMDLs with the same public review period.

EPA will submit the final version of this TMDL to LDEQ for implementation and incorporation into LDEQ's current water quality management plan.

7.0 REFERENCES

KDHE. 2005. "Kansas TMDL Curve Methodology." Web site maintained by Kansas Department of Health and Environment. Dated December 1, 2005. www.kdhe.ks.gov/tmdl/Data.htm.

LDEQ. 2005a. Louisiana 2004 Final Integrated Report, Appendix A. Online at www.deq.Louisiana.gov/portal/Portals/0/planning/305b/2004/04IR1-FINAL-Appendix A with FINAL U.S. EPA ADDITIONS-August 17, 2005.pdf

LDEQ. 2005b. Title 33 Environmental Quality, Part IX Water Quality. Online at www.deq.Louisiana.gov/portal/Portals/0/planning/regs/title33/33v09.doc

Standard Methods. 1999. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Published by American Public Health Association, American Water Works Association, and Water Environment Federation.

USGS. 2000. National Land Cover Data Set 1992. Published by U.S. Geological Survey. Online at http://landcover.usgs.gov/natllandcover.php

Zar, J.H. 1996. Biostatistical Anlyses, 3rd ed. Prentice Hall. New Jersey

APPENDIX A

Maps

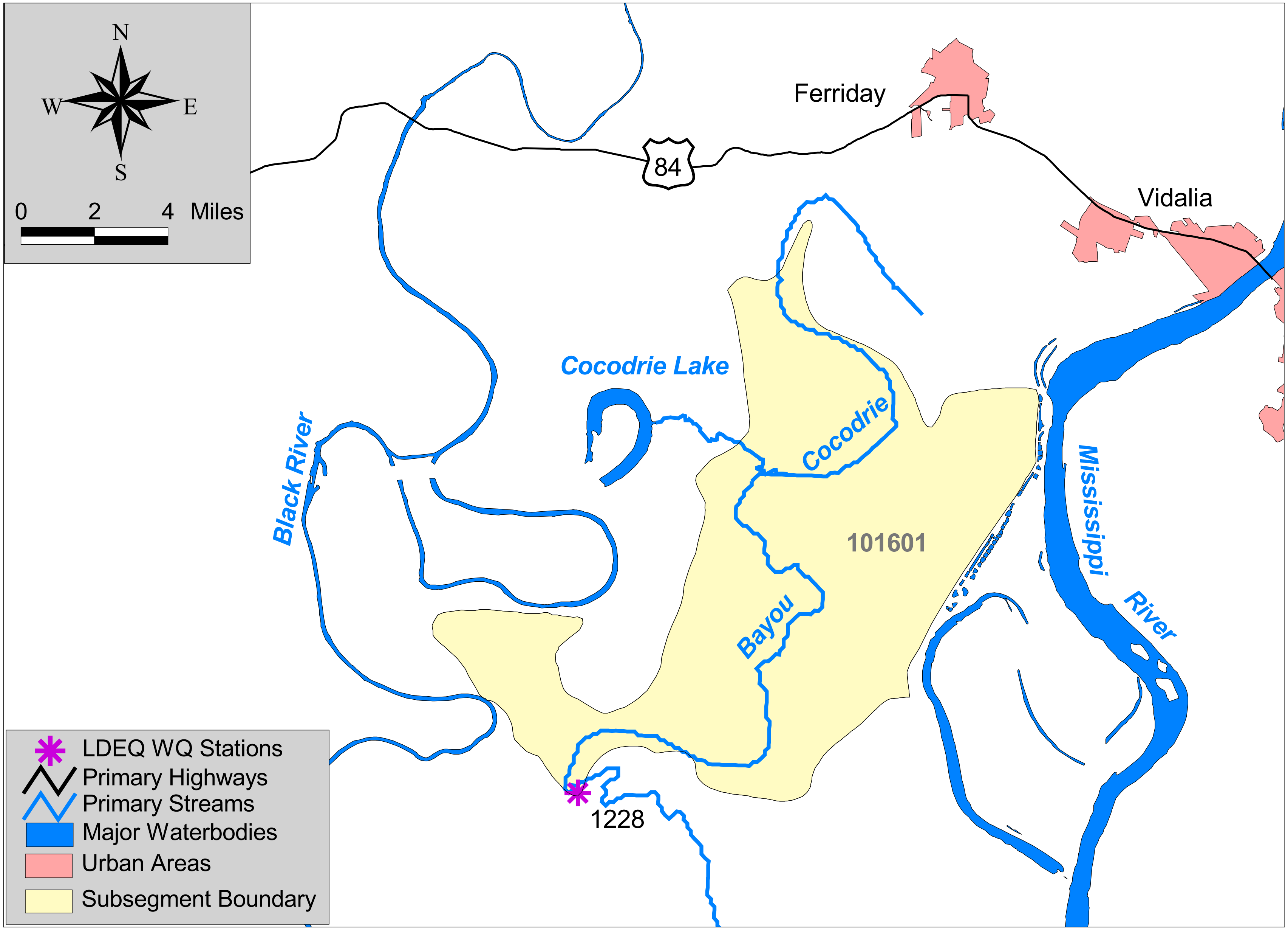


Figure A.1. Watershed map for subsegment 101601.

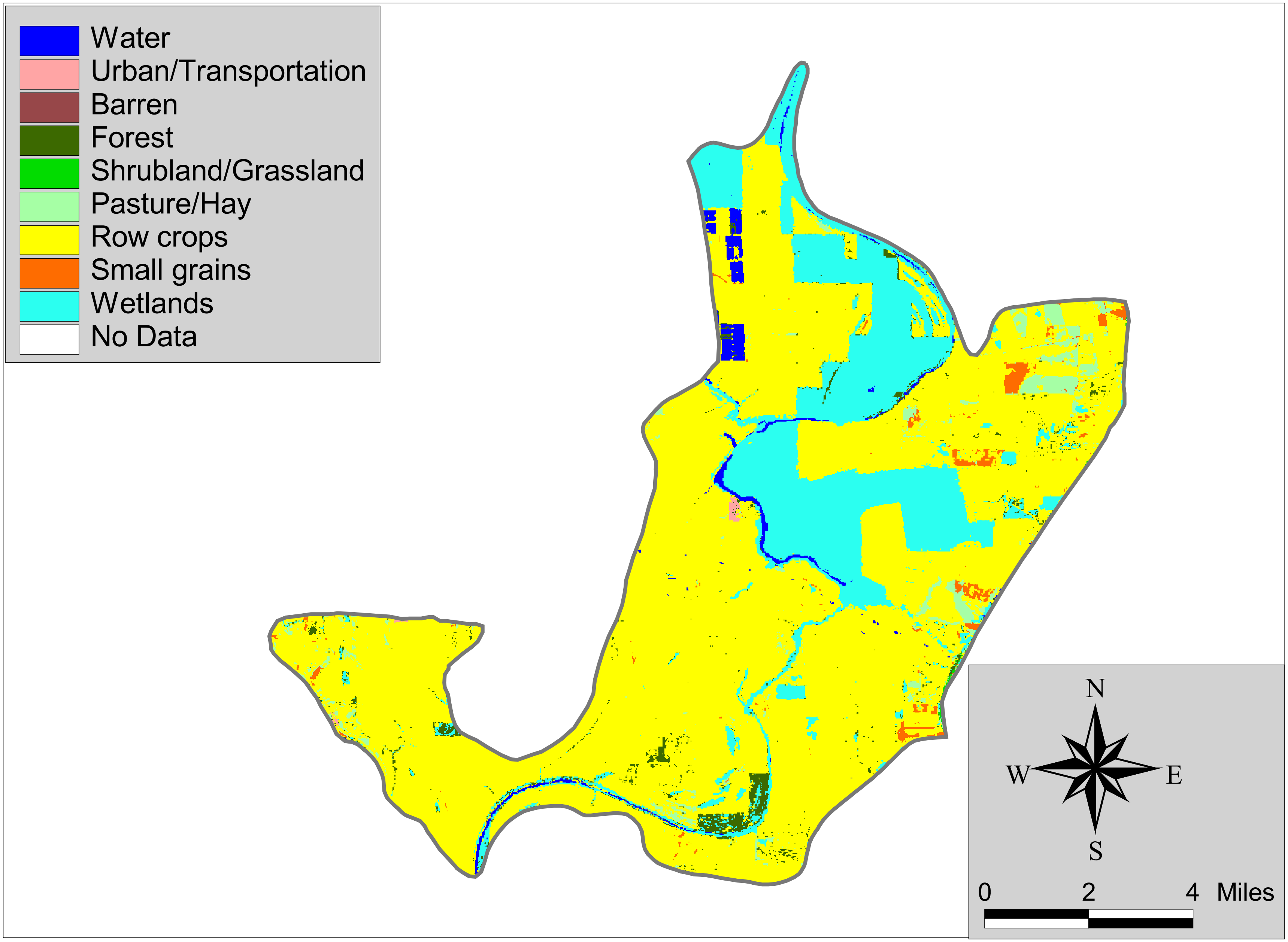


Figure A.2 Land use for subsegment 101601.

APPENDIX B

Turbidity and TSS Data

Figure B.1 Observed Turbidity for Bayou Cocodrie south of Monterey, LA (1228)

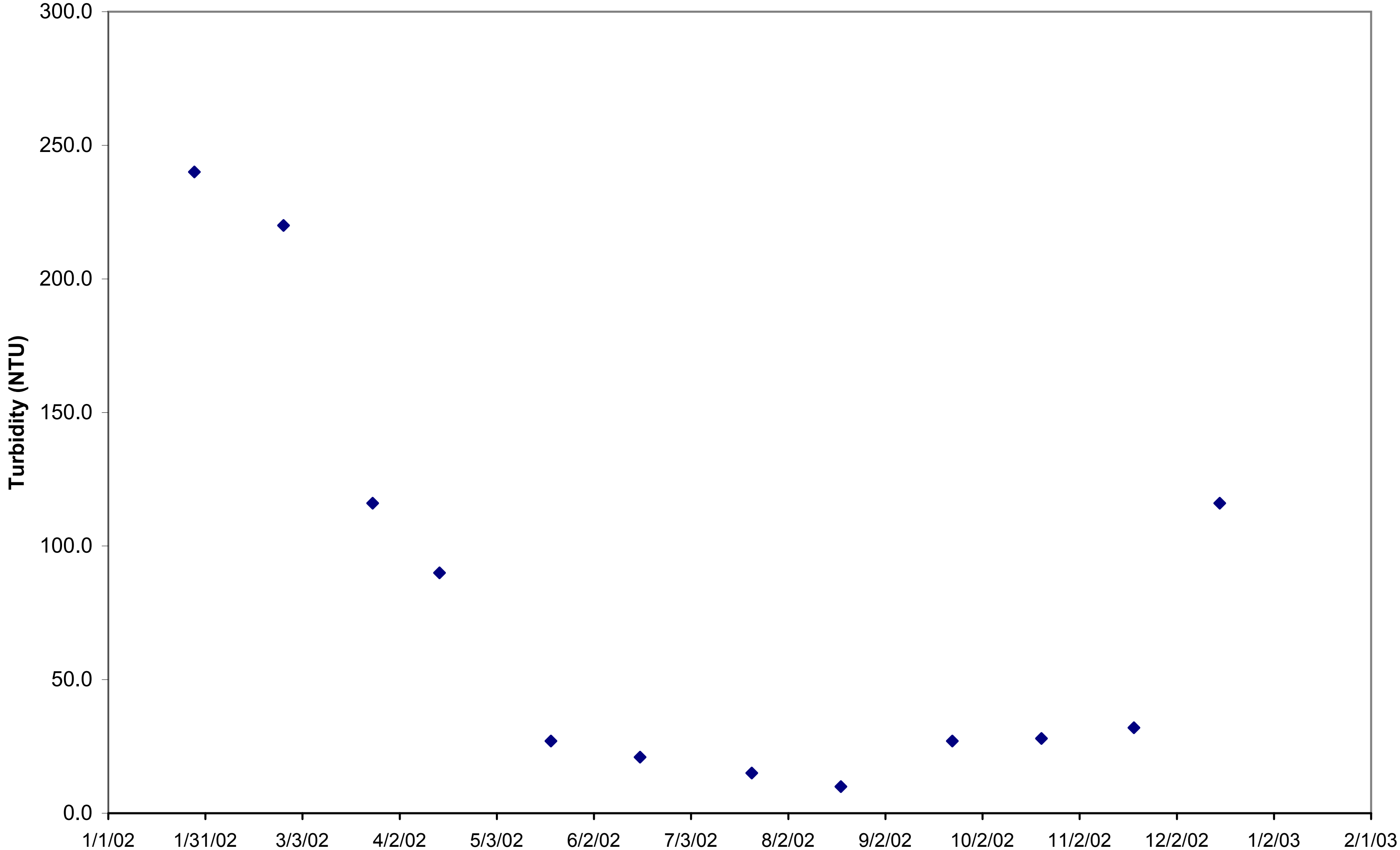


Figure B.2 Observed TSS for Bayou Cocodrie south of Monterey, LA (1228)

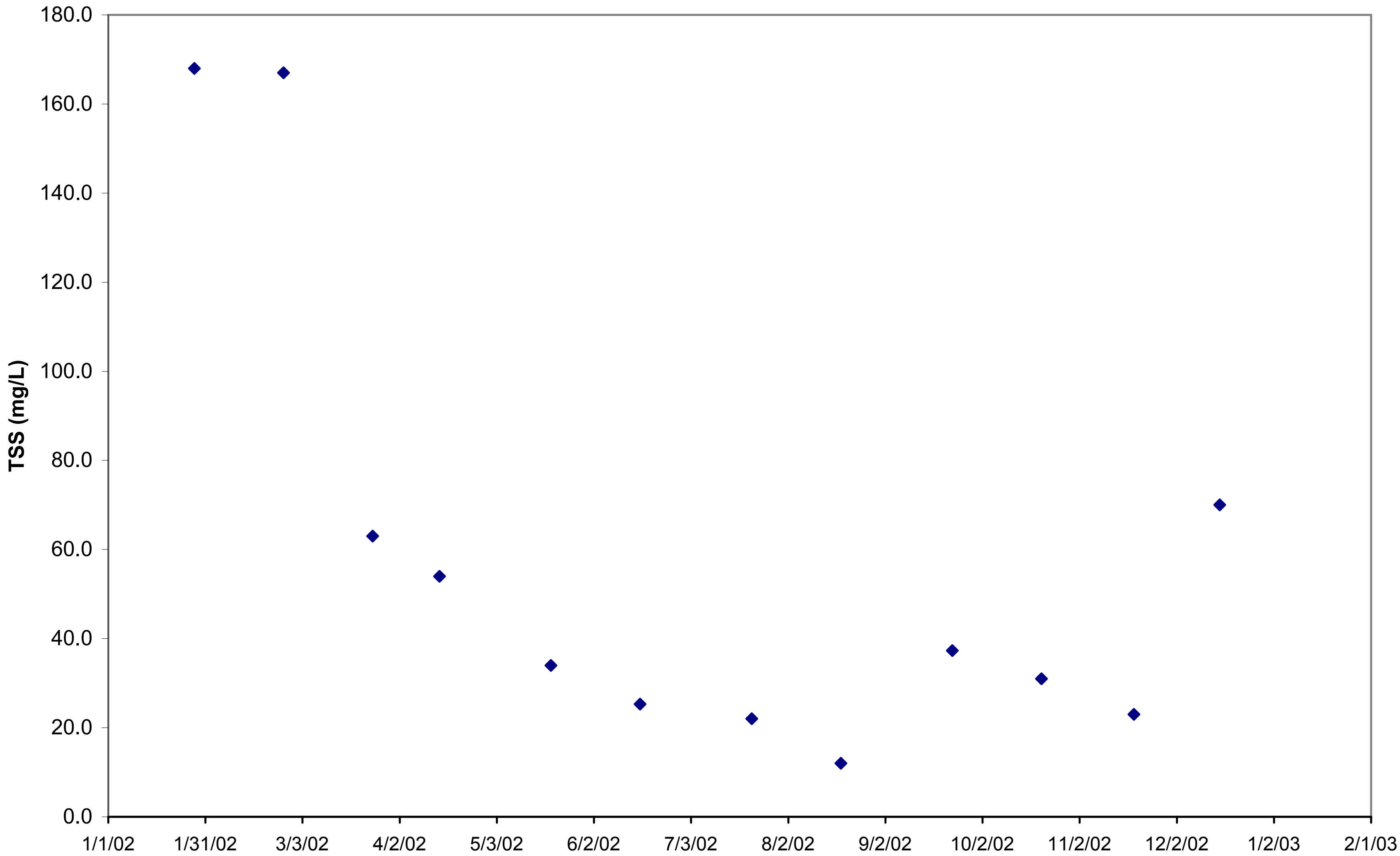


Figure B.3 Turbidity vs Flow for Bayou Cocodrie south of Monterey, LA (1228)

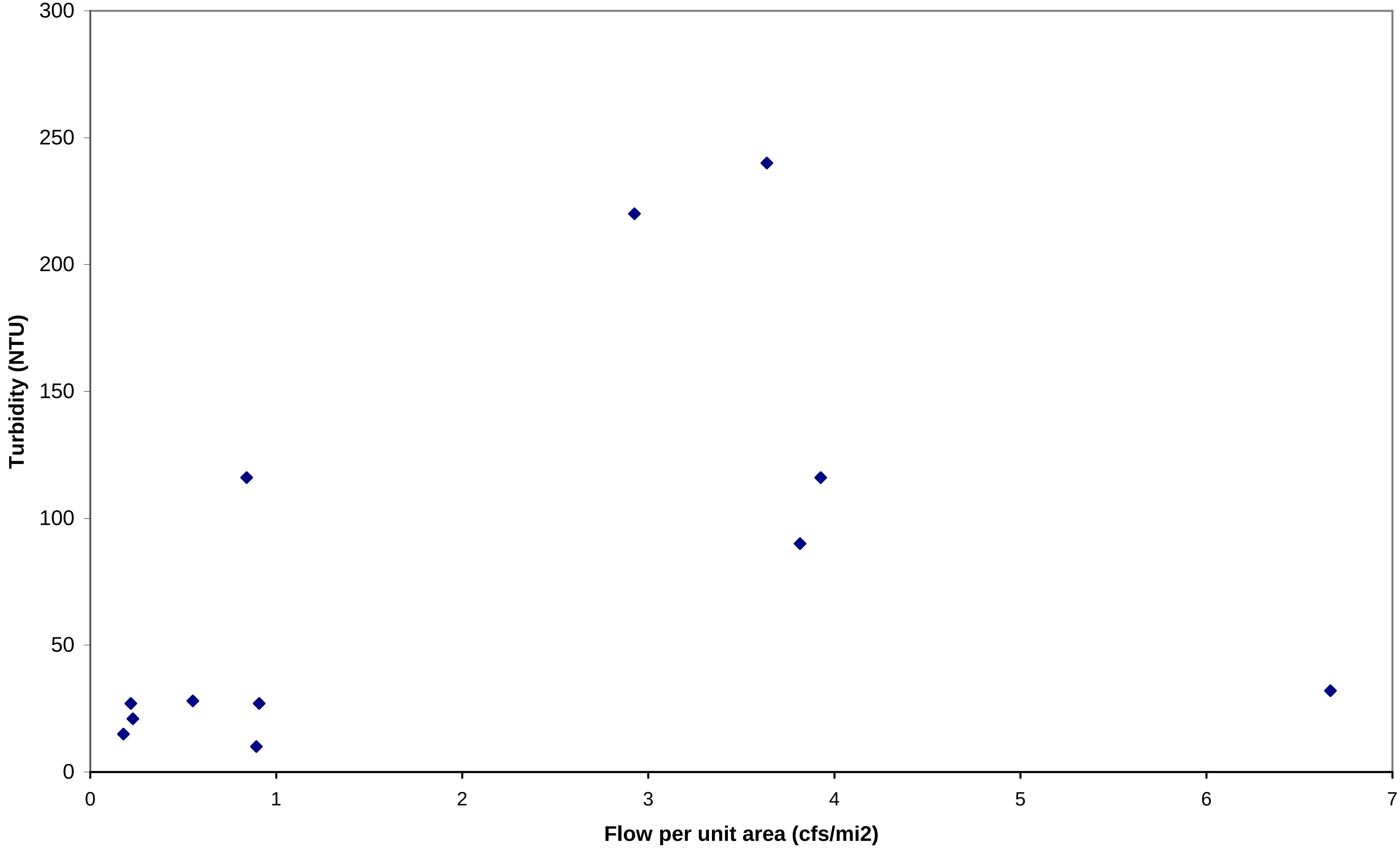


Figure B.4 TSS vs flow for Bayou Cocodrie south of Monterey, LA (1228)

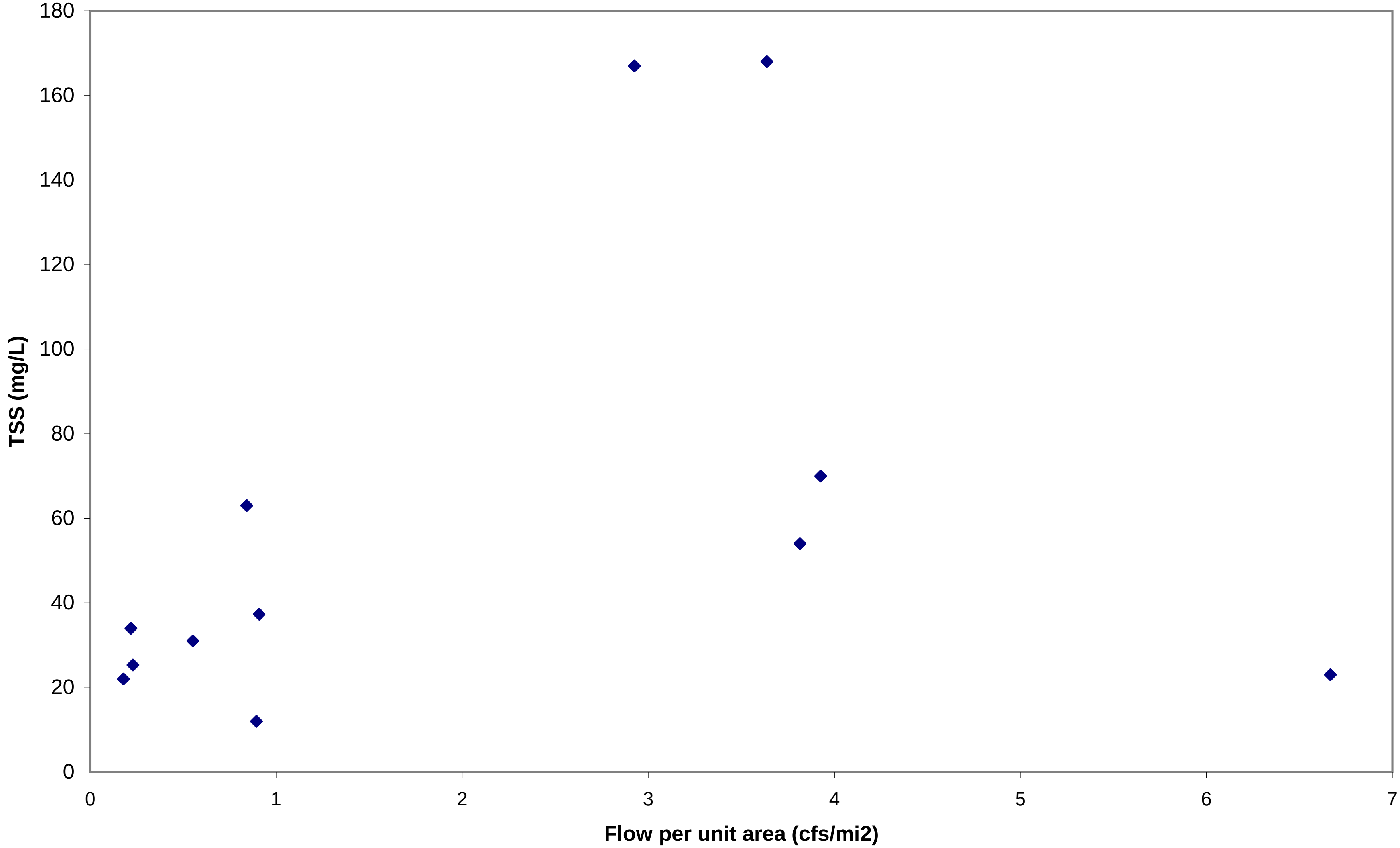
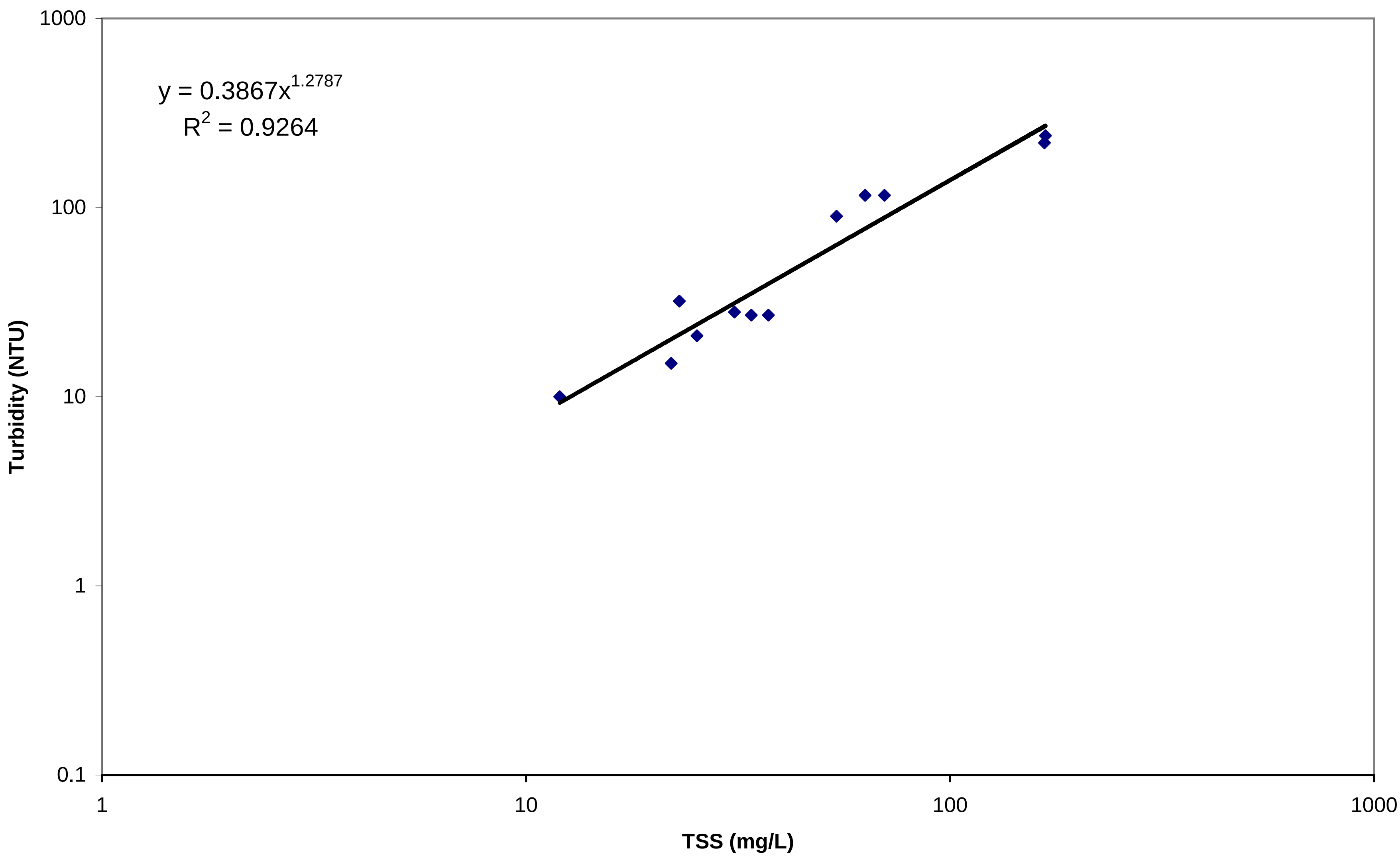


Figure B.5 Turbidity vs. TSS for Bayou Cocodrie south of Monterey, LA (1228)



APPENDIX C

Calculation for Subsegment 101601 TSS TMDL

TABLE C.1 ALLOWABLE LOAD FOR TSS FOR BAYOU COCODRIE S MONTEREY, LA (1228)

drainage	270	mi2, of gage	25	NTU = TURB standard
	99.20	mi2, of watershed 101601	26.1	mg/L = TSS Target

TSS Target 225.35 lbs/day/mi2

Date	Bayou Des Glaises Div. Ch. flow (cfs)	Percent non exceed-ance	Percent exceed-ance	Flow per unit area (cfs/mi2)	Flow per unit area (cms/mi2)	Width on plot between data points (unitless)	TSS TMDL load (lbs/day/mi2)	TSS TMDL - FG load (lbs/day/mi2)	Area under TMDL curve (width times TMDL load) (lbs/day/mi2)
10/29/2000	2.6	0.00	100.00	0.010	2.726E-04	0.00462	1.36	1.22	6.26E-05
10/30/2000	2.6	0.01	99.99	0.010	2.726E-04	0.00462	1.36	1.22	6.26E-05
10/26/1964	2.8	0.01	99.99	0.010	2.936E-04	0.00462	1.46	1.31	6.74E-05
10/27/1964	2.8	0.02	99.98	0.010	2.936E-04	0.00462	1.46	1.31	6.74E-05
10/13/1972	2.8	0.02	99.98	0.010	2.936E-04	0.00462	1.46	1.31	6.74E-05
10/14/1972	2.8	0.03	99.97	0.010	2.936E-04	0.00462	1.46	1.31	6.74E-05
10/31/2000	2.8	0.03	99.97	0.010	2.936E-04	0.00462	1.46	1.31	6.74E-05
10/11/1972	2.9	0.03	99.97	0.011	3.041E-04	0.00462	1.51	1.36	6.99E-05

For brevity, most of the rows in this spreadsheet have been hidden (between the 99.97% and the 0.03% exceedances).

5/27/1953	4,680	99.97	0.03	17.333	0.491	0.00693	2,439.78	2,195.80	1.69E-01
4/13/1995	4,700	99.97	0.03	17.407	0.493	0.00462	2,450.20	2,205.18	1.13E-01
5/24/1953	4,830	99.97	0.03	17.889	0.506	0.00462	2,517.97	2,266.18	1.16E-01
5/26/1953	4,860	99.98	0.02	18.000	0.510	0.00462	2,533.61	2,280.25	1.17E-01
5/25/1953	4,910	99.98	0.02	18.185	0.515	0.00462	2,559.68	2,303.71	1.18E-01
4/12/1995	5,200	99.99	0.01	19.259	0.545	0.00462	2,710.86	2,439.78	1.25E-01
5/19/1953	5,640	99.99	0.01	20.889	0.591	0.00462	2,940.24	2,646.22	1.36E-01
5/18/1953	6,030	100.00	0.00	22.333	0.632	0.00462	3,143.56	2,829.20	1.45E-01
								TOTAL =	225.35

FILE: R:\PROJECTS\2110-617\TECH\TMDL\FTN\RED\FINAL TMDL BAYOU COCODRIE S MONTEREY, LA 1228.XLS

TABLE C.2 EXISTING LOAD AND PERCENT REDUCTION FOR TSS FOR BAYOU COCODRIE S MONTEREY, LA (1228)

TSS Target = 26 mg/L
Percent reduction needed = 87%

Error check for reduction is / is not needed: ok
Error check for less or more reduction needed: ok

Date	Observed TSS at stn 1228 (mg/L)	Flow per unit area on sampling day (cms/mi2)	Percent exceedance for flow on sampling day	Current TSS load (lbs/day)/mi2	Reduced TSS load (lbs/day)/mi2	TMDL - FG TSS load (lbs/day)/mi2	Reduced load less than or TMDL - FG?
28-Jan-02	168.00	0.10	15.90	3,295.23	428.38	460.74	Yes
25-Feb-02	167.00	0.08	22.04	2,635.17	342.57	370.66	Yes
25-Mar-02	63.00	0.02	43.56	285.65	37.13	106.51	Yes
15-Apr-02	54.00	0.11	14.61	1,110.96	144.42	483.27	Yes
20-May-02	34.00	0.01	70.73	40.07	5.21	27.68	Yes
17-Jun-02	25.30	0.01	69.71	31.33	4.07	29.09	Yes
22-Jul-02	22.00	0.01	75.35	21.09	2.74	22.52	Yes
19-Aug-02	12.00	0.03	42.52	57.76	7.51	113.07	Yes
23-Sep-02	37.30	0.03	42.25	182.53	23.73	114.95	Yes
21-Oct-02	31.00	0.02	51.08	92.26	11.99	69.91	Yes
19-Nov-02	23.00	0.19	3.17	826.92	107.50	844.54	Yes
16-Dec-02	70.00	0.11	13.83	1,482.07	192.67	497.34	Yes

Total number of values =	12
Allowable % of exceedances =	0%
Allowable no. of exceedances =	0
No. of exceedances before reductions =	8
No. of exceedances after reductions =	0

Total allowable loading per unit area to meet TSS Target (from Table C.1) =	225.35	lbs/day/mi2
Total allowable loading for Subsegment 101601 = 225.35 * 99 mi2 =	11.18	tons/day
Explicit MOS for TSS for Subsegment 101601 (implicit) =	0.00	tons/day
Future growth for TSS for Subsegment 101601 (10% of TMDL) =	1.12	tons/day
Sum of design flows for point sources of TSS for Subsegment 101601 =	0.000	cms

Assumed effluent TSS concentration for point sources =	0	mg/L
Existing point source TSS load for Subsegment 101601 =	0.00	tons/day
WLA for TSS for Subsegment 101601 (same as existing Point Source load) =	0.00	tons/day
LA for TSS for Subsegment 101601 = total - MOS - WLA - FG =	10.06	tons/day

FILE: R:\PROJECTS\2110-617\TECH\TMDL\FTN\RED\FINAL TMDL BAYOU COCODRIE S MONTEREY, LA 1228.XLS

Figure C.1. Flow Duration Curve for Bayou Des Glaises Diversion Channel at Moreauville, LA (07383500)

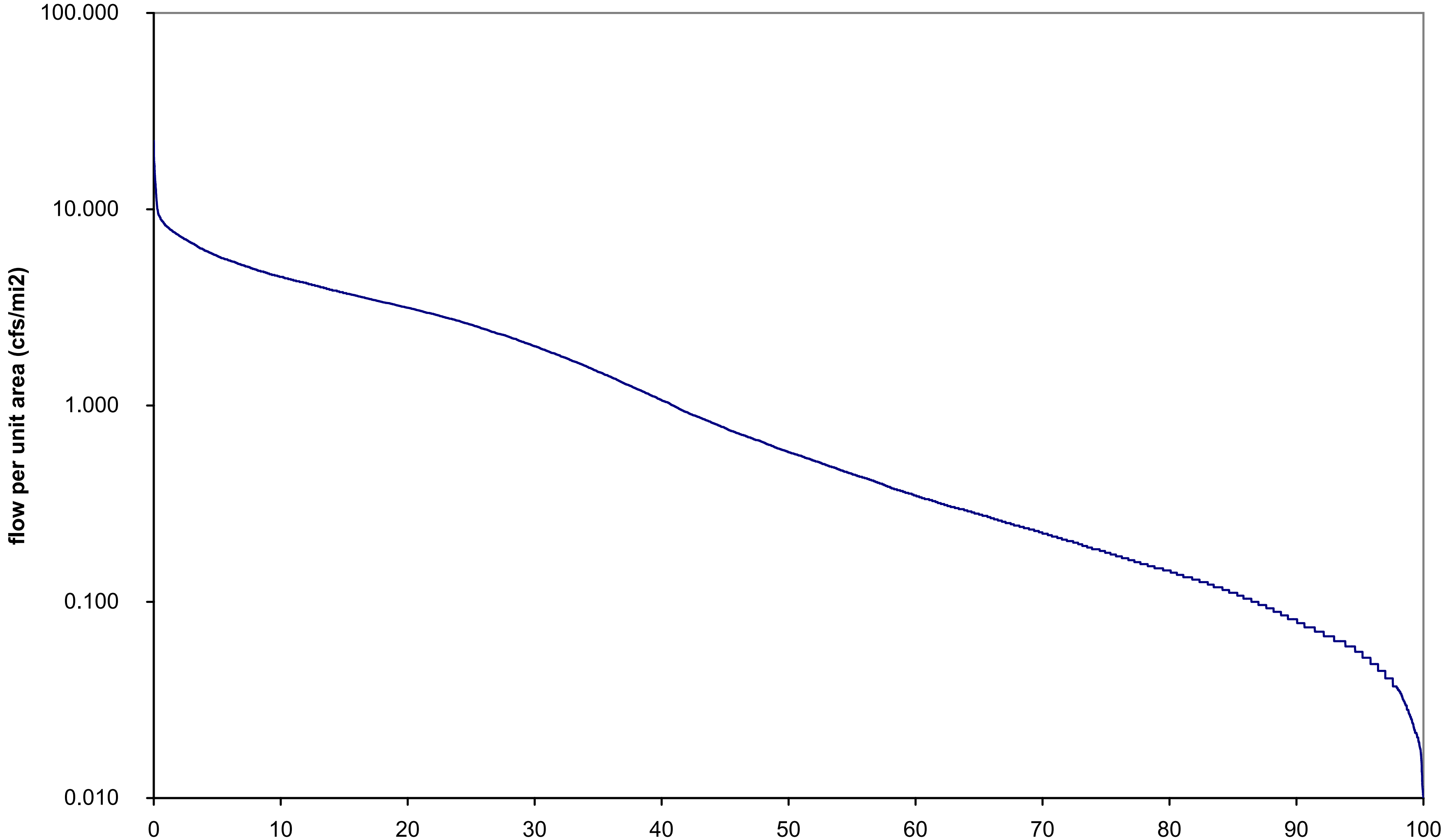
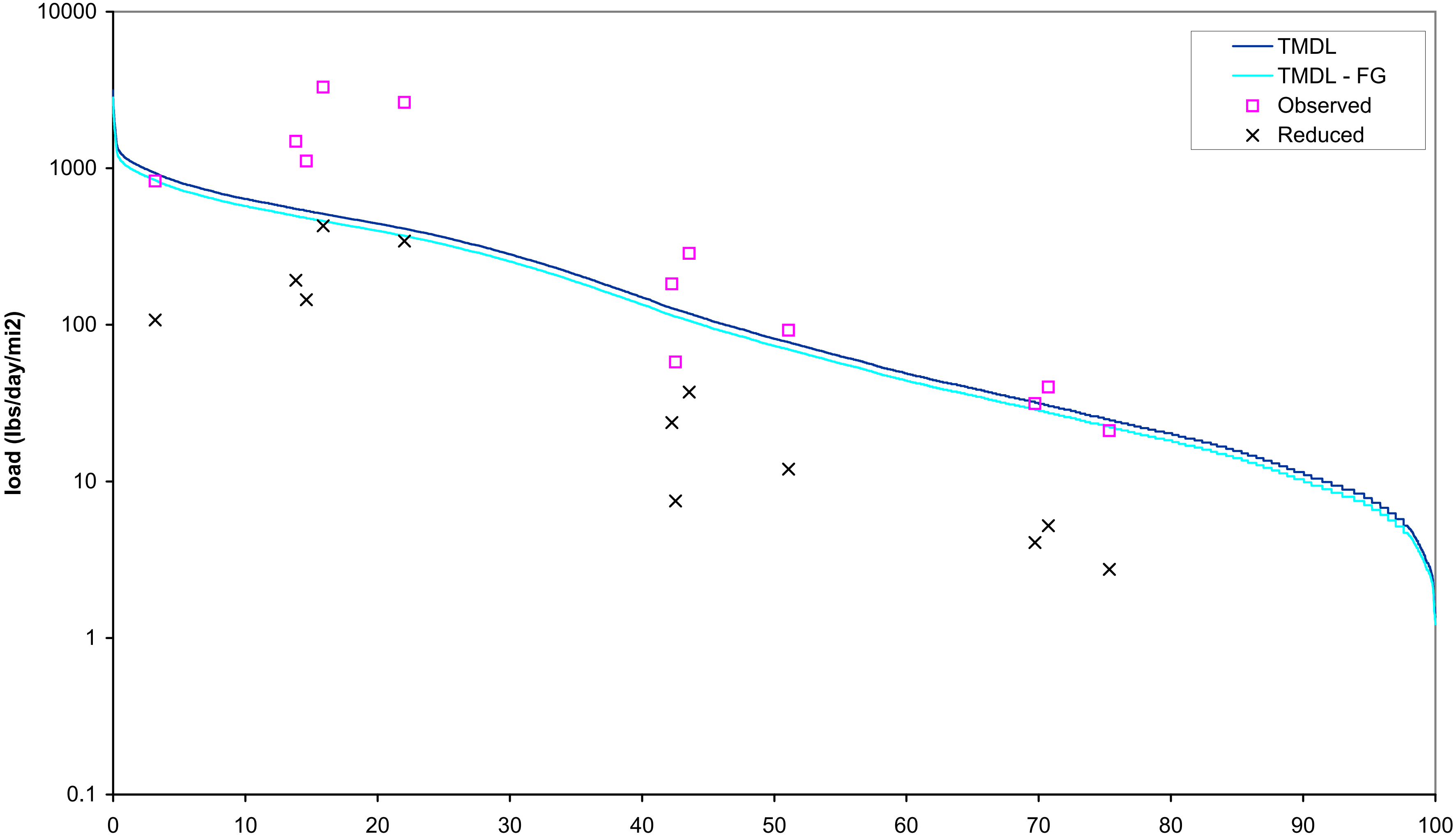


Figure C.2. TSS Load Duration Curve for Bayou Cocodrie (101601)



APPENDIX D

Electronic Copy of TMDL Calculations (on CD inside back cover)